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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Zhidan TOLT	Docket No.:	nanogate120303
Serial No.:	10/707,342	Group Art Unit:	2815
Filed:	December 5, 2003	Examiner:	Fenty, Jesse

For: **LOW VOLTAGE ELECTRON SOURCE WITH SELF ALIGNED GATE APERTURES, FABRICATION METHOD THEREOF, AND LUMINOUS DISPLAY USING THE ELECTRON SOURCE**

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL FOR RESPONSE TO NOTICE OF NON-COMPLIANT AMENDMENT

☒ Transmitted herewith are the following documents for the above-referenced application:

☒ 9 Page Response to Notice of Non-Compliant Amendment.

The Commissioner is authorized to charge any required fees or credit any overpayment associated with this filing to Deposit Account 50-2778.

Respectfully submitted,

DECHERT LLP

Dated: September 13, 2005

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CERTIFICATE OF FACSIMILE TRANSMISSION
Total Pages Faxed: 10 (including transmittal)

I hereby certify that this correspondence is being forwarded via facsimile to Examiner Jesse Fenty in Group No. 2815 at facsimile number (571) 273.8300 & (703) 872.9306 located at Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA, 22313-1450, on September 13, 2005.

Date: September 13, 2005

Yolette Yurquide-Owen

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RESPONSE TO NOTICE OF NON-COMPLIANT AMENDMENT

In response to the Notice of Non-Compliant Amendment mailed on August 18, 2005, please amend the above identified application as follows.

IN THE CLAIMS:

Please cancel without prejudice or surrender of subject matter Claims 1-34 and add the claims as indicated below.

Claims 1-34 (canceled)

34. (New) An emission electron source comprising:

a cathode electrode disposed on a substrate, the cathode electrode for providing a source of electrons;

an emitter layer disposed over said cathode electrode and formed from a composition of an embedding material and one or a plurality of nano-structures embedded therein, the emitter layer having a surface, the nano-structures being truncated parallel to the surface and having portions protruding above the surface to emit electrons;

an insulator disposed over the emitter layer, the insulator having one or a plurality of apertures, each exposing at least the ends of the nano-structures in the emitter layer; and

a gate electrode disposed over the insulator and having one or plurality of apertures, wherein each aperture is concentrically self-aligned with the end of one of the nano-structures, so as to expose a single nanostructure and provide each nano-structure with substantially the same emitter-to-gate distance, the gate electrode being operative to control the emission of electrons through the apertures from the exposed nano-structures;

wherein the nano-structures have a coating for enhanced field emission performance.

35. (New) An emission electron source comprising:

a cathode electrode disposed on a substrate, the cathode electrode for providing a source of electrons;

an emitter layer disposed over said cathode electrode and formed from a composition of an embedding material and one or a plurality of nano-structures embedded therein, the emitter layer having a surface, the nano-structures being truncated parallel to the surface and having portions protruding above the surface to emit electrons;

an insulator disposed over the emitter layer, the insulator having one or a plurality of apertures, each exposing at least the ends of the nano-structures in the emitter layer; and

a gate electrode disposed over the insulator and having one or plurality of apertures, wherein each aperture is concentrically self-aligned with the end of one of the nano-structures, so as to expose a single nanostructure and provide each nano-structure with substantially the same emitter-to-gate distance, the gate electrode being operative to control the emission of electrons through the apertures from the exposed nano-structures.

36. (New) An electron source as recited in claim 35, wherein said nano-structures are substantially vertical.

37. (New) An electron source as recited in claim 35, wherein said nano-structures are individually spaced apart.

38. (New) An electron source as recited in claim 35, wherein said emitter-to-gate distance for each nano-structure is substantially less than one micrometer.

39. (New) An electron source as recited in claim 35, wherein the nano-structures have a surface density substantially higher than $10^6/cm^2$.

40. (New) An electron source as recited in claim 35, wherein the nano-structures protrude above the surface of the emitting layer for not more than half of one micrometer.

41. (New) An electron source as recited in claim 35, wherein the apertures in the insulator expose the entire protrusion portion of the nano-structures in the emitting layer.

42. (New) An electron source as recited in claim 35, wherein the nano-structures have at least one of their three dimensions in the nanometer range.

43. (New) An electron source as recited in claim 35, wherein the nano-structures include

nano-tubes, nano-wires, nano-fibers, and nano-cones.

44. (New) An electron source as recited in claim 35, wherein the nano-structures have a coating for enhanced field emission performance.

45. (New) An electron source as recited in claim 35, wherein the nano-structures are selected from a group of materials consisting of carbon, refractory metals and alloys, conductive ceramics, conductive ceramic composites, and doped semiconductors.

46. (New) An electron source as recited in claim 45, wherein the carbon includes carbon nano-tube, carbon nano-fiber, and carbon nano-cone.

47. (New) An electron source as recited in claim 35, wherein the nano-structures comprise a nonconductive core and a conductive shell.

48. (New) An electron source as recited in claim 47, wherein the nonconductive core is made from one of wide band gap semiconductors, including diamond, BN, AlN, AlGaN, GaN, GaAs, SiC, and ZnO.

49. (New) An electron source as recited in claim 35, wherein the embedding material is comprised of at least two layers.

50. (New) An electron source as recited in claim 49, wherein the first layer of the embedding material is conductive.

51. (New) An electron source as recited in claim 35, wherein the insulator and the embedding material are composed of the same dielectric material.

52. (New) An electron source as recited in claim 35, wherein said insulator functions also as the embedding material.

53. (New) An electron source as recited in claim 35,

wherein the cathode electrode is configured as a plurality of electrically isolated cathode electrodes, each for supplying an independent source of electrons;

wherein the gate electrode is configured as a plurality of electrically isolated electrodes, each intersecting with said cathode electrodes and having one or a plurality of apertures at each intersections, each gate electrode being operative to control the emission of electrons through the apertures along the gate electrode; and

wherein activation of a selected cathode and a selected gate electrode determines an intersection where the nano-structures emit electrons.

54. (New) An electron source comprising:

a substrate;

electrode means, disposed over the substrate, for providing a source of electrons;

means, disposed over the source means, for emitting electrons provided by the source means, the emitting means including a one or a plurality of nano-structure emitting means for providing a flow of electrons and means for supporting the nano-structure emitting means;

an insulator disposed over the emitting means; and

one or a plurality of gating means, disposed over the insulator, for controlling the flow of electrons emitted by the nano-structure emitting means, each of said gating means arranged symmetrically relative to one of the nano-structure emitting means.

55. (New) An electron source as recited in claim 54, wherein the insulator and the gating means each include one or more apertures that expose the nano-structure emitting means.

56. (New) An electron source as recited in claim 54, wherein the nano-structure emitting means has at least one of its three dimensions in the nanometer range.

57. (New) An electron source as recited in claim 54, wherein the nano-structure emitting means includes carbon nano-tube, carbon nano-fiber, and carbon nano-cones.

58. (New) An electron source as recited in claim 54, wherein the nano-structure emitting means is substantially vertical.

59. (New) An electron source as recited in claim 54, wherein the nano-structure emitting means is an array of individually spaced apart nano-structures.

60. (New) A display comprising:

an electron source that includes:

a cathode electrode disposed on a substrate, the cathode electrode for providing a source of electrons;

an emitter layer disposed over said cathode electrode and formed from a composition of an embedding material and one or a plurality of nano-structures embedded therein, the emitter layer having a surface, the nano-structures being truncated parallel to the surface and having portions protruding above the surface to emit electrons;

an insulator disposed over the emitter layer, the insulator having one or a plurality of apertures, each exposing at least the ends of the nano-structures in the emitter layer; and

a gate electrode disposed over the insulator and having one or plurality of apertures, wherein each aperture is concentrically self-aligned with the end of one of the nano-structures, so as to expose a single nanostructure and provide each nano-structure with substantially the same emitter-to-gate distance, the gate electrode being operative to control the emission of electrons through the apertures from the exposed nano-structures; and

an anode plate including a transparent anode electrode disposed over a glass substrate and a phosphor screen disposed over the anode electrode, the anode plate being positioned opposite to said electron source with a vacuum gap disposed therebetween;

wherein electrons are emitted from said nano-structures by applying a voltage between said cathode and gate electrodes, and are made incident on said phosphor screen to make luminous said phosphor screen.

61. (New) A display as recited in claim 60, wherein the nano-structures are substantially

vertical.

62. (New) A display as recited in claim 60, wherein the emitter-to-gate distance for each emitter is substantially less than one micrometer.

63. (New) A display as recited in claim 60, wherein the nano-structures have a surface density substantially higher than $10^6/cm^2$.

64. (New) A display as recited in claim 60,

wherein the cathode electrode is configured as a plurality of strip-like cathode electrodes extending substantially in the same direction in such a manner as to be spaced from each other at intervals in the transverse direction, each cathode strip for providing an independent source of electrons;

wherein the gate electrode is configured as a plurality of strip-like gate electrodes extending in such a manner as to intersect said plurality of cathode electrodes and to be spaced from each other at intervals in the transverse direction, and having one or a plurality of apertures at each intersection, each gate electrode for controlling the emission of electrons through the apertures along the gate electrode; and

wherein the anode electrode is configured as a plurality of strip-like anode electrodes each extending in such a manner as to be opposed to the corresponding one of said gate electrodes.

REMARKS

With respect to Item 2 and regarding claims 35 and 60, Applicant submits that the Choi '367 reference fails to teach each and every limitation of Applicant's invention as recited in those claims, because the reference fails to teach the limitation "a gate electrode disposed over the insulator and having one or plurality of apertures, wherein each aperture is concentrically self-aligned with the end of one of the nano-structures, so as to expose a single nanostructure and provide each nano-structure with substantially the same emitter-to-gate distance, the gate electrode being operative to control the emission of electrons through the apertures from the exposed nano-structures," which is present in both claims. Applicant's invention achieves this resulting structure because of the way it is fabricated. In contrast, the reference teaches the use of a particle masking technique to achieve a gate aperture structure. However, the particle masking techniques taught in the reference cannot achieve the limitation set forth and therefore the reference does not teach such a structure. First, the technique in the reference purposefully includes a multiplicity of nanoconductors in each aperture. Choi, Col. 7, line 64 to Col. 8, line 3. In contrast, Applicant's invention, in claims 35 and 60, recites that each of the apertures is concentrically self-aligned with the end of one of the nano-structures, so as to expose a single nanostructure[1]. Second, the technique in the reference does not contemplate the alignment of an aperture about each one of the nano-structures. This is clear from FIG. 11 of the reference and the description of the particle mask technique. Clearly, the range in the size of the particles (1-5 μm) is such that multiple nano-structures will become exposed by the aperture and thus there is no concept of aligning the aperture with those multiple structures. Choi, Col. 8, lines 46-53. Therefore, the Choi reference fails to teach each and every limitation of Applicant's invention as recited in claims 35 and 60.

[1] Error in this sentence was corrected from original amendment filed August 8, 2005.

Thus, in light of the above, Applicants respectfully request reconsideration and allowance of the pending claims and the new claims in the above-mentioned application.

Respectfully submitted,

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Dated: September 13, 2005

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